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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/410,737

10/01/1999

DELPHINE ANH DAO LE

169.1476

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05/17/2004

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EXAMINER

LAROSE, COLIN M

ART UNIT

PAPER NUMBER

2623

DATE MAILED: 05/17/2004

18

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/410,737

Applicant(s)

LE ET AL.

Examiner

Colin M. LaRose

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 22 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-67 is/are pending in the application.
- 4a) Of the above claim(s) 1-9,25-29,48-50,53,57-59 and 62 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20-24,30-34,46,47,54,56,63,65 and 67 is/are allowed.
- 6) ☒ Claim(s) 10-12,15-19,35,39,40,43,45,51,52,55,60,61 and 64 is/are rejected.
- 7) ☒ Claim(s) 13,14,36-38,41,42,44 and 66 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 20 February 2004 has been entered.

### *Response to Amendments and Arguments*

2. Applicant has amended claims 10, 12, 35, 51, 52, 55, 60, 61, and 64 to denote that the subset of border pixels that are considered (or scanned) is smaller in number than the total number of border pixels.

Applicant asserts that Ikonomakis does not disclose or suggest "scanning only a strict subset of the pixels that border the growing regions" (see page 36, paper 14). Examiner agrees with this assertion that Ikonomakis does not disclose scanning only a subset of pixels that is less than the total number of border pixels. As previously established, Ikonomakis discloses considering (or scanning) each and every border pixel.

Applicant also asserts that Ikonomakis is silent as to "considering a number of pixels bordering the regions, the number being smaller than a total number of pixels bordering the regions" (see page 35, paper 14). Examiner disagrees with this assertion, since it does not preclude the consideration of all border pixels. Ikonomakis considers all of the border pixels,

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which includes the consideration of any (and all) groupings of pixels less than the total number of pixels.

Examiner appreciates that the present invention considers only a lesser subset of the total number of border pixels. However, the claims, as presently presented, do not preclude the consideration of all of the border pixels. They only require at least one pixel to be considered.

The claims can be distinguished from Ikonomakis by stating that only a lesser subset of the total number of border pixels is considered, but absent such a restriction on the number of pixels to be considered, the limitation in question is still believed to be anticipated by Ikonomakis.

3. Applicant has amended claims 10, 35, 51, 55, 60, and 64 to denote that, after appending a most similar pixel to the region, the property of the expanded region is updated. Applicant has amended claims 12, 52, and 61 to denote that an updated property of the region is calculated as a function of the region's prior property and the property of the appended pixel.

Ikonomakis does not disclose these features. Ikonomakis teaches updating the property of the appended pixel rather than the property of the expanded region that includes the appended pixel.

Adams is relied upon below to cure this deficiency in Ikonomkais.

***Claim Rejections - 35 USC § 103***

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

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5. Claims 10, 11, 35, 39, 51, 55, 60, and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over “Region Growing and Region Merging Image Segmentation” by Ikonomakis et al. (“Ikonomakis”) in view of “Seeded Region Growing” by Adams et al. (“Adams”).

Regarding claims 10, 35, 51, 55, and 60, and 64 Ikonomakis discloses a method of segmenting an image comprising:

allocating pixels as seeds (column 2, page 299, lines 1+: start with a set of seed pixels);  
growing regions from the seeds so as to segment the image into regions (column 2, page 299, lines 2+: grow regions from the seeds),

wherein a number of pixels that border the regions are considered, the number being smaller than a total number of pixels that borders the regions (column 2, page 299, lines 7+: seed pixel is compared to its 8 neighbors, which, as explained above, comprises a smaller subset of neighboring pixels),

and the considered pixel that is most similar in a property to a region bordered by the considered pixel is appended to the region to form an expanded region and the property of the appended pixel is updated (column 2, page 299, lines 8+: border pixels that satisfy a similarity function (including the most similar pixel) are appended to the region and changed to the seed pixel value) and said growing step is repeated until no pixels bordering the regions are available (column 2, page 299, lines 22+: growing step is repeated until no border pixels are left).

Ikonomakis does not disclose updating the property of the expanded region, as claimed.

Adams discloses a system for segmenting an image by seeded region growing that is similar to that of Ikonomakis. Adams, like Ikonomakis, places seeds in the image and then grows

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homogeneous regions based on those seeds. However, whereas Ikonomakis teaches appending a pixel to a region, and then simply changing the value of the appended pixel to coincide with the value of the region, Adams teaches appending a pixel to a region, and then using the mean of the expanded region for comparison to potential appended pixels (page 642, columns 1 and 2). That is, Adams does not change the value of the appended pixel so that it (as well as all of the pixels in the region) has the same value as the seed pixel, as taught by Ikonomakis. Rather, Adams simply appends a pixel a region when the value of the pixel is sufficiently close to the mean of the region. Then, the updated mean of the region (including the appended pixel) is calculated and compared to the value of the current border pixels for determining whether a pixel of interest should be appended. See equation (1), page 642.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to achieve the claimed invention by utilizing Adams' method for appending pixels so as to update the property of the expanded regions (viz. appending pixels to regions without changing their [the appended pixels'] values, and then computing the updated mean of the expanded region for comparison), since Adams shows that comparing potentially appended pixels to the mean of an expanded region that includes previously appended pixels is a functionally equivalent alternative to the pixel-appending methods of Ikonomakis and produces desirable segmentation results, as noted by Adams in the 2<sup>nd</sup> paragraph of column 2 of page 641.

Further regarding claims 35, 55 and 64, Ikonomakis discloses allocating/distributing pixels as seeds in those areas of the image as a function of the luminance of the pixels within those areas (column 2, page 299, lines 5-22: a first seed pixel produces a first region of

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homogeneity, then a second pixel outside of the first region is specified as a second seed pixel, and subsequently produces a second region of homogeneity different from the first region; thus the seed pixels are allocated as a function of the luminance of homogeneous areas), wherein fewer seeds are allocated to those areas of the image having pixels of homogeneous luminance (each region is allocated only one seed; therefore, areas of the image having pixels of homogeneous luminance (i.e. encompass only one region) are allocated fewer seeds than those regions that are not homogeneous (i.e. encompass more than one region) and wherein said seeds form growing regions (i.e. each subsequent seed forms a new growing region).

Regarding claims 11 and 39, Adams discloses said property is the grey-value (luminance) of the pixels, expressed as a mean grey value (see equation 1, page 642).

6. Claim 12, 15-18, 40, 43, 52, and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ikonomakis in view of "Seeded Region Growing" by Adams et al. ("Adams").

Regarding claims 12, 40, 52, and 61, Ikonomakis discloses a method of segmenting an image into regions, the image comprising a plurality of pixels, comprising:

allocating pixels as seeds (as in claim 10);

growing regions from the seeds, wherein the growing comprises:

scanning a subset of pixels that border the growing regions, the number of pixels in the subset being smaller than the number of total border pixels, and determining for each border pixel, a value indicative of the similarity of a property of the scanned pixel and the corresponding property of a region that the border pixel borders (column 2, page 299, lines 7+:

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the eight pixels that border the seed pixel (which is in the growing region) are scanned and the similarity of the border pixels to the seed pixel in terms of luminance is determined by  $|G - G_s|$ ;

selecting a pixel that is most similar in the property to the region that said border pixel borders (column 2, page 299, lines 27+: a selected border pixel is appended to the growing region if it has a minimal difference value (this includes the most similar border pixel));

appending the selected pixel to the region bordered by the selected pixel (column 2, page 299, lines 10+: pixel is assigned to the region);

calculating an updated property of the region that includes the appended pixel (column 2, page 299, lines 9+: the luminance value of an appended pixel(s) (which comprises the appended region) is changed to the seed pixel value); and

repeating the growing steps until there are no more border pixels (column 2, page 299, lines 23+: growing steps are repeated until no border pixels are left).

Ikonomakis does not expressly disclose generating a list of the border pixels and scanning the pixels of the generated list.

Adams discloses a similar region-growing method for segmenting images that comprises generating a sequentially sorted list, or SSL, which contains neighboring pixels of growing regions (column 2, page 642, lines 12+). Neighboring pixels are stored in the list according to their similarity measures. The list is scanned in a predetermined manner, and pixels are removed until the list is empty.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to generate a list of border pixels and scan the pixels of the list



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as claimed since Adams shows that utilizing a linked list of pixel addresses facilitates the labeling of boundary pixels into the their corresponding regions.

Also regarding claims 12, 52, and 61, Ikonomakis does not disclose updating the property of the region as a function of the prior region's property and the property of the appended pixel, as claimed.

Adams discloses a system for segmenting an image by seeded region growing that is similar to that of Ikonomakis. Adams, like Ikonomakis, places seeds in the image and then grows homogeneous regions based on those seeds. However, whereas Ikonomakis teaches appending a pixel to a region, and then simply changing the value of the appended pixel to coincide with the value of the region, Adams teaches appending a pixel to a region, and then using the mean of the expanded region for comparison to potential appended pixels (page 642, columns 1 and 2). That is, Adams does not change the value of the appended pixel so that it (as well as all of the pixels in the region) has the same value as the seed pixel, as taught by Ikonomakis. Rather, Adams simply appends a pixel a region when the value of the pixel is sufficiently close to the mean of the region. Then, the updated mean of the region (including the appended pixel) is calculated as a function of the mean of the previous region and the value of the appended pixel, and is then compared to the value of the current border pixels for determining whether a pixel of interest should be appended. See equation (1), page 642.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to achieve the claimed invention by utilizing Adams' method for appending pixels so as to update the property of the expanded regions as a function of the

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prior region's property and the property of the appended pixel (viz. appending pixels to regions without changing their [the appended pixels'] values, and then computing the updated mean of the expanded region for comparison), since Adams shows that comparing potentially appended pixels to the mean of an expanded region that includes previously appended pixels is a functionally equivalent alternative to the pixel-appending methods of Ikonomakis and produces desirable segmentation results, as noted by Adams in the 2<sup>nd</sup> paragraph of column 2 of page 641.

Regarding claim 15, Adams discloses said property is the grey-value of the pixels, expressed as a mean grey value (see equation 1, page 642).

Regarding claim 16, Adams teaches the claimed similarity measure (equation 1, page 642).

Regarding claim 17, Ikonomakis discloses the said value is determined in accordance with a metric in color space (equation 1, page 300).

Regarding claim 18, Ikonomakis discloses merging the grown regions which have similarities (column 1, page 300, lines 21+: after growing, merging is done).

Regarding claim 43, Ikonomakis discloses merging neighboring regions as claimed (column 2, page 299, lines 21+).

7. Claims 19 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ikonomakis and Adams in view of "Image Segmentation and Approximation Through Surface Type Labelling and Region Merging" by Lim et al. ("Lim").

Regarding claims 19 and 45, Ikonomakis discloses

determining for each pair of neighboring grown regions a clique function value representative of the similarity of said property of said pair of neighboring grown regions; and merging a pair of regions to produce a merged region if the clique function is less than a predetermined threshold (column 1, page 300, lines 32+: homogeneity (clique) function between neighboring regions and a merging threshold is used to merge regions whose value is less than the threshold – this includes the selection of the regions with the smallest clique function value and the comparison of their clique values to the threshold to determine if the regions should be merged).

Ikonomakis does not expressly disclose updating the merged regions' clique functions.

Lim discloses a similar method for merging segmented regions. Lim teaches selecting the region with the lowest measure of dissimilarity and repeatedly merging each subsequent selected region on the condition that the measure of dissimilarity does not exceed an error threshold value (column 1, page 1381, paragraph 5). Also, when two regions are merged, the measures of dissimilarity between the new region and its neighbors are updated.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the merging sub-steps of Ikonomakis by Lim to achieve the claimed invention since Lim teaches that the claimed merging sub-steps have good performance, a lower approximation error, and a reduced processing time (column 2, page 1381, paragraph 1).

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***Allowable Subject Matter***

8. Claims 13, 14, 36-38, 41, 42, 44, and 66 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. Claims 20-24, 30-34, 46, 47, 54, 56, 63, 65, and 67 are allowable.

Regarding claims 14, 20, 42, 46, 56, and 65, neither Ikonomakis nor Adams discloses using, for scanning the list of pixels, a step size that is a function of the length of the list, as claimed.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colin M. LaRose whose telephone number is (703) 306-3489. The examiner can normally be reached Monday through Thursday from 8:00 to 5:30. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au, can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2600 Customer Service Office whose telephone number is (703) 306-0377.


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3 May 2004



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